Original Article

Effect of Postoperative Bleaching on Microleakage of Etch-and-Rinse and Self-etch Adhesives

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ABSTRACT

Background: Bleaching the discoloured teeth may affect the tooth/composite interface. The aim of this in vitro experimental study was to evaluate the effect of vital tooth bleaching on microleakage of existent class V composite resin restorations bonded with three dental bonding agents.

Methods: Class V cavities were prepared on buccal surfaces of 72 intact, extracted human anterior teeth with gingival margins in dentin and occlusal margins in enamel, and randomly divided into 3 groups. Cavities in the three groups were treated with Scotch bond Multi-Purpose, a total etch system and Prompt L-Pop and iBond, two self-etch adhesives. All teeth were restored with Z250 resin composite material and thermo-cycled. Each group was equally divided into the control and the bleached subgroups (n = 12). The bleached subgroups were bleached with 15% carbamide peroxide gel for 8 hours a day for 15 days. Microleakage scores were evaluated on the incisal and cervical walls. Data were analyzed using Kruskal-Wallis, Mann-Whitney and Bonferroni post-hoc tests ($\alpha = 0.05$).

Results: Bleaching with carbamide peroxide gel significantly increased the microleakage of composite restorations in Prompt L-Pop group at dentinal walls ($P = 0.001$). Bleaching had no effect on microleakage of restorations in the Scotch bond Multi-Purpose and iBond groups.

Conclusion: Vital tooth bleaching with carbamide peroxide gel has an adverse effect on marginal seal of dentinal walls of existent composite resin restorations bonded with prompt L-Pop self-etch adhesive.

***Keywords*:** Bonding agents, Composite resins, Dental adhesives, Dental etching, Dentin, Tooth bleaching.

Received: *August 2010*
Accepted: *November 2010*

Dent Res J 2011; 8(1): 16-21

Introduction

The demand for having more esthetic teeth and restorations has led several studies to be done in the field of tooth bleaching and its effects on the properties of teeth and the quality of composite restorations.[1,2] While altered surface texture, hardness, fracture toughness[3,4] and increased surface roughness of enamel,[5] have been reported, some studies have shown little or no effect on the physical properties of enamel.[6,7] Hydrogen peroxide has been suspected to cause denaturation of proteins in the organic components of dentin and enamel,[8] reduce microhardness values[9] and result in changes in the mechanical properties of dentin,[4] and could reduce the bond between resin restorations and tooth.[10] It is suggested that dentin is more affected by hydroxide base materials due to its less mineral content and more organic matrix.[11]

The success of composite restorations depends on bonding them to hard tooth tissue that will retain the restoration to the cavity preparation and prevent microleakage.[4] The dental adhesives used in dentistry have different tooth-composite interface morphologists,[12,13] different bond strengths[14-16] and different abilities in microleakage preven-

* This paper derived from a doctoral thesis and a research project No. 82283 in Isfahan University of Medical Sciences.

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tion.[17-19] So, the bonded interfaces may be affected by the bleaching agents differently.

Some researchers have investigated the effects of preoperative bleaching on microleakage and sealing ability of tooth coloured restorative materials.[20-22] Some researchers also have studied the effects of bleaching agents on microleakage of existence restorations. The researches done by Crim[23], Owens et al.[24], Ulukapi et al.[25] and Moosavi et al[26]. have indicated that bleaching is an effective factor on the sealing ability of existent composite restorations whereas Klukowska et al.,[27] Khoroushi et al.[28] and White et al.[29] showed that bleaching had no influence on microleakage of composite restorations.

The purpose of this in vitro experimental study was to evaluate the effect of bleaching with carbamide peroxide on the microleakage of existent composite restorations treated with one etch and rinse and two self etch adhesive systems.

Materials and Methods

Seventy two non-carious extracted human anterior teeth were selected, cleaned and stored in 0.2% thymol solution until ready to use. Standardized class V cavity preparations (3 × 2 × 2 mm) were placed in the buccal surfaces at the cemento-enamel junction, with the incisal margins in enamel and the gingival margins in cementum. The enamel margin of restoration was bevelled with a carborundum point (Shofu, Kyoto, Japan). Teeth were randomly divided into 6 groups of 12 specimens each (3 control and 3 experimental or bleached groups). After completion of the preparations, the bonding agents, Scotch bond Multipurpose (3M-ESPE), Prompt L-Pop(3M-ESPE) and iBond (Heraeus-Kulzer) were applied according to the manufacturers' instructions (Table 1) on the control and bleached groups to form SC and SB, PC and PB, IC and IB groups, respectively. The cavities were incrementally restored with a light curing composite material, Filtek Z 250 (3M-ESPE,), in a total of 3 equal increments, each one photoactivated for 40 seconds (Coltolux II, Coltene, Switzerland). The restorations were finished and polished with polishing disks (Sof-Lex, 3M ESPE). After 24 hours, all teeth were thermo-cycled for 500 cycles between 5 ± 2°C and 55 ± 2°C with dwell time of 30S for each and a transfer time of 10S (Mp Based, KARA 1000, Tehran, Iran).

The bleached group's teeth were bleached with vital bleaching method. The teeth were bleached with 15% carbamide peroxide gel (Opalescence PF, Ultradent, Products Inc, USA) for 8 hours/day during 15 days. The teeth were stored at 37°C during the bleaching procedures. The control groups also were stored in the same environment. All teeth thermocycled for 500 cycles between 5 ± 2°C and 55 ± 2°C with dwell time of 30S for each and a transfer time of 10S (Mp Based, KARA 1000, Tehran, Iran).

Apical opening of teeth were occluded with resin composite. The tooth surfaces were covered with two coats of nail varnish except for the restorations and 1 mm from the margins and then, immersed in 0.5% basic fuchsin solution for 24 hours at room temperature. Teeth were stored in artificial saliva (pH = 7.4) except during the bleaching process, thermocycling and dye penetration testing. Then, the teeth were sectioned longitudinally in a buccolingual direction using a cutting machine (Dentarapid, Krupp Dental 759 DR 2, Hilzingen, Germany). The degrees of dye penetration in the enamel and dentin cavity walls were assessed separately under a stereomicroscope (Olympus Co, Tokyo, Japan) at x16 magnification. The following microleakage scores were used to assess the extent of dye penetration at the dentin and enamel walls: 0= no dye penetration, 1 = dye penetration less than halfway to the axial wall, 2= dye penetration greater than half way to the axial wall but not involving it, and 3= dye penetration along the axial wall. The data were analyzed using Kruskal-Wallis test followed by Mann-Whitney and Bonferroni's correction for multiple testing ($\alpha = 0.05$).

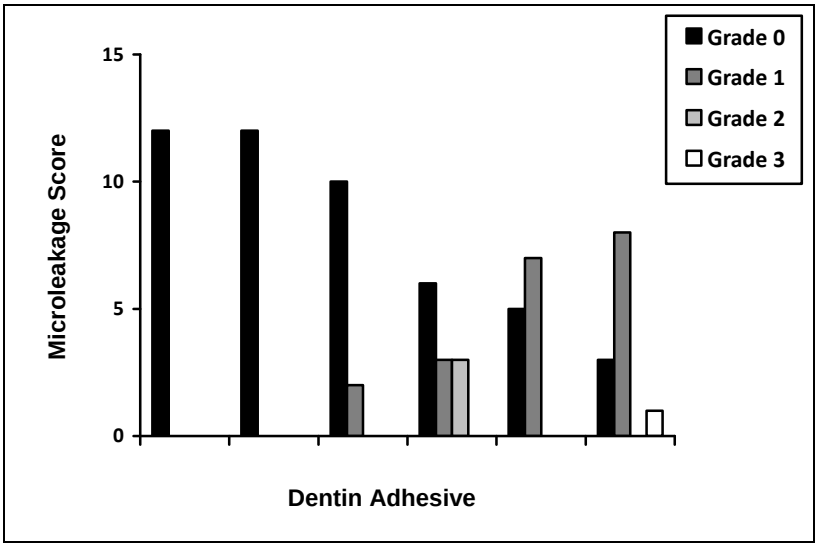
Table 1. Technique used for each adhesive

Adhesive	technique
Scotch bond Multipurpose	Etch 15 seconds, 35%H3PO4,rinse Apply primer, air dry Apply adhesive, light polymerize
Prompt L-Pop	Mix using unit-dosed blister pack Apply with agitation for 15 seconds Air thin, light polymerize
iBond	Shake the bottle Apply adhesive three times

Air dry, Light polymerize

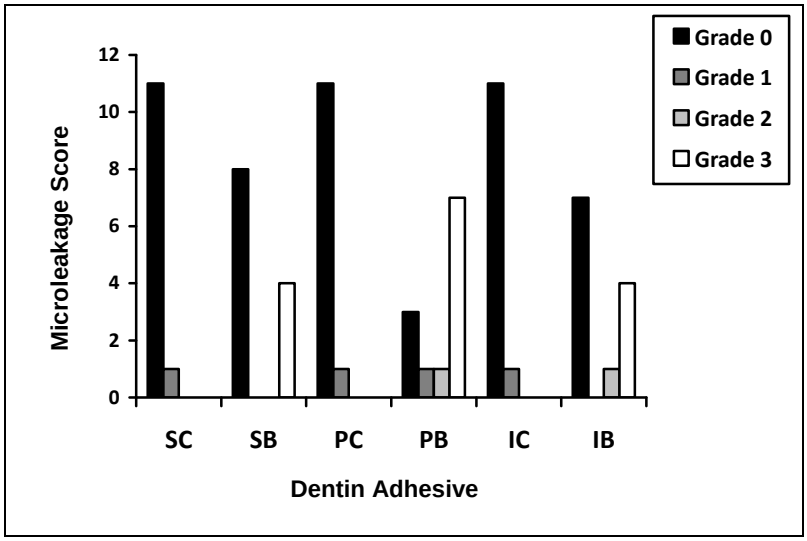
Results

Degrees of microleakage for enamel and dentinal walls are presented in figures 1 and 2. There was no significant difference between the microleakage scores of the control and bleached groups of each adhesive at the enamel margins (Scotch bond Multipurpose, P = 1.000, Prompt L-Pop, P = 0.061, iBond, P = 0.252). There was also no significant difference between the control and bleached groups of Scotch bond Multipurpose and iBond for gingival margins (P = 0.102 and P = 0.054, respectively). However, for Prompt L-Pop group, dentinal micro-leakage increased after bleaching (P = 0.001).



Sc: Scotch bond Multi-Purpose Control, SB: Scotch bond Multi- Purpose Bleached, PC: Prompt L-Pop Control, PB: Prompt L-Pop Bleached, IC: i Bond Control, IB: i Bond Bleached

Figure 1. Micro leakage degrees of the control and bleached groups of three bonding agents at the enamel margins.



Sc: Scotch bond Multi-Purpose Control, SB: Scotch bond Multi- Purpose Bleached, PC: Prompt L-Pop Control, PB: Prompt L-Pop Bleached, IC: i Bond Control, IB: i Bond Bleached

Figure 2. Micro leakage degrees of the control and bleached groups of three bonding agents at the ginival margins.

There was a significant difference among the control groups of three dentin bonding agents for enamel walls (P = 0.004). This difference for dentinal walls was not significant. The microleakage scores of enamel walls for iBond control group were significantly greater than that for Scotch bond Multipurpose (P = 0.002) and Prompt L-Pop (P = 0.010). There was no significant difference between the control groups of Scotch bond Multipurpose and Prompt L-Pop at enamel walls (P = 0.148).

There was a significant difference among the bleached groups of three adhesives at enamel margins (P = 0.002). These differences for dentinal walls were not significant (P = 181). The bleached group of Scotch bond Multipurpose showed significantly less microleakage at the enamel wall compared to Prompt L-Pop (P = 0.006) and iBond (P < 0.001). There was no significant difference between Prompt L-Pop and iBond in scores of microleakage at enamel margins of bleached groups.

Discussion

Under the condition of this study, the two self etch adhesives, Prompt L-Pop and iBond, showed compatible results to the etch and rinse adhesive, Scotch bond Multipurpose, in gingival margins of unbleached teeth. Although most of the self-etching products evaluated in the literature appear to produce adhesion to dentin that is no worse than their total etch predecessors[16,30] and compatible marginal seal,[17,18] concerns remains about the ability of such products to adequately seal enamel margins, and to bond to enamel with sufficient strength to retain large composite restorations.[31]

In this study, there was no statistically significant difference between the control groups of Prompt L-Pop self etch adhesive and Scotch bond Multipurpose Total etch adhesive in enamel walls that was not in agreement with the research by Brackett et al.[32] Also, in our research, iBond self etch adhesive showed the worst results in enamel margins in both control and bleached groups. This finding is in agreement with the results of researches that showed more microleakage scores for iBond compared to Scotch bond Multipurpose in unbleached teeth.[19,32] In another study in contrast to ours, iBond did not exhibit more microleakage scores than Scotch bond Multipurpose did.[33]

Van Meerbeek et al. classified self etching products as "strong", "intermediate" or "mild", according to their pH. Strong is referred to those having a pH value of 1 or less and mild are products with PH values about 2. It has been proved that the strong self-etching adhesives create more effective etching patterns in enamel than the milder ones do.[12] Since iBond has a pH of bout 2.1[34] and Prompt L-Pop has a pH of 1 or less, this difference could be the cause of the greater degrees of enamel microleakage in iBond compared to Prompt L-Pop.

The results of this study suggest that in the situation of using Scotch bond Multipurpose as an adhesive system, bleaching has no significant effect on rising the enamel and gingival microleakage scores of existent restorations. It seems that the appropriate bond in cavity margins[35,36] are likely to protect the restorations margins from the risk of peroxide penetration. This fact besides it's least microleakage scores in the control groups, could be the indicators of the effectiveness of this adhesive for clinical applications.

For Prompt L Pop adhesive, bleaching caused a significant rising in microleakage scores in dentinal margin whereas in the enamel, no significant change in microleakage was seen. These findings indicate that dentinal margins may be more affected by bleaching agents when this self-etching adhesive system is used. These effects may be due to less mineral content and more organic matrix of dentin.[11] Either hydrogen peroxide or carbamide peroxide may denature dentin proteins, resulting in morphological changes that could reduce the bond between resin restorations and dentin.[10] The exposure of dentin to bleaching agents reduces microhardness values[9] and the alterations in dentinal organic/inorganic composition may also result in changes in mechanical properties of dentin[4] that may make it more prone to be affected by bleaching agents.

Ulukapi et al. suggested that both pre and post operative bleaching with 10% carbamide peroxide can increase microleakage scores of composite restorations margins.[25] These findings are not in agreement with our results regarding Scotch bond multipurpose and i Bond groups, and would be due to differences between the kinds of adhesives and restorative materials, bleaching time and some other factors. Khoroushi et al.[28] showed that light activated bleaching did not significantly affect the microleakage of existing tooth-colored restorations restored with Single Bond adhesive resin and Z100 resin composite, Prompt L-Pop adhesive resin and

F2000 compomer. The findings for Prompt L-Pop at gingival margin in her study were not similar to ours. Maybe using Prompt L-Pop with F2000 compomer material according to manufactures recommendation led to better dentinal margin sealing.

Klukowska et al.[27] explored the effects of different concentrations of hydrogen peroxide and carbamide peroxide agents on the enamel margin microleakage of composite restorations. In their study and also in White et al.[29] research, in agreement with ours, bleaching agents could not increase the microleakage scores of Filtek Z250 bonded with Scotch bond. Moosavi et al. found that postoperative bleaching with carbamide peroxide could increase microleakage in the dentinal margins of composite restorations. Their results were in agreement with ours.[26]

Conclusion

Under the condition of this study:

1. Post operative bleaching could increase the microleakage scores of composite restorations dentinal margins, treated with Prompt L-Pop self-etching adhesive. However, this procedure did not affect enamel margins.

2. Scotch bond Multipurpose total etch adhesive exhibited the best enamel and dentinal marginal sealing among bleached groups.

3. iBond showed the most enamel microleakage among unbleached groups of three adhesives.

Acknowledgement

This article was prepared based on a doctoral thesis and a research project (# 82283) approved by the Medical Ethics and Research Office at the Isfahan University of Medical Sciences.

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